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54 System for protection and disconnection of electrical lines.

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The present invention relates to a single-unit electrical device that meets IEC [International Electrotechnical Commission] standards for at least two consumer subscriber loops, which device consists of an integral assembly that includes a multipolar breaker switch for the input line, a differential device (i.e., an actuation-detection device for a differential current) to provide protection against contact voltage, and two or more thermomagnetic breakers (one for each outgoing line), to provide protection against overloads and short circuits.

According to the CEZ *[sic; "CEI" is the correct abbreviation here – Tr.]* standards and international standards in general, the entry point of each user loop or installation should be equipped with devices whose components are designated by the symbols currently in use, shown schematically in Figure 1, and that are suitable for providing the following functions:

1) An overall multipolar shutdown of the incoming line, in order to take the entire user installation out of service, when (for example) maintenance work needs to be performed. The device may be either a manual breaker switch or an automatic switch or breaker.

2) Protection against overloads and short circuits for the individual lines in the various sections adjacent to the subscriber (downstream of the main breaker switch or cut-off). Small domestic installations usually have two of these lines, i.e., one line for the lighting circuits (to supply electricity for lighting fixtures and for the sockets or outlets intended to handle comparable loads), and one for the power circuits (to supply electricity for major household appliances, such as water heaters, washing machines, and dishwashers); however, they may also be provided in greater numbers, depending on the size of the installation and the number of loads to be handled.

3) Protection against contact voltages that entail a risk of electrocution. This protection is sometimes provided by combining an automatic main breaker with the earth resistance of the local installation; however, in most cases, it is provided by replacing the automatic breaker with a differential switch.

As a general rule, the devices [1] [2] and [7] that correspond to functions (1) (2) and (3), each of which devices is contained in a housing whose shape is represented by a dashed line, are located in an enclosure or "small central panel" whose shape is the one indicated hereinabove, in which enclosure the installer makes the connections between the devices, as well as the link with the power cable and the output lines.

A known device, shown in Figure 2, implements the arrangement shown in Figure 1 for an individual subscriber. In this arrangement, reference [11] designates the thermomagnetic breaker and reference [12] designates the differential device, each of which has a manual-control lever [17] or push-button [18].

The breaker [11] is a automatic unipolar, bipolar, or multipolar current breaker that has its own thermal relay [13] and electromagnetic relay [14]. It has a trigger mechanism [16] that ensures the opening of the line contact and that can also be actuated by the thermal relay or by the electromagnetic relay, even from the differential device [12].

The trigger mechanism [16] includes one or more springs (not shown) to which tension is applied when the two levers [17] and [18], in that order, are placed in the interlocking position.

When the coil of the trigger mechanism [16] is excited by the transformer [15] receiving the fault-current signal to ground, a locking device (not shown) releases the springs that cause the opening of the breaker [11]. In case of an overcurrent, this opening can also be controlled by the thermal relay [13] or by the electromagnetic relay [14].

Furthermore, according to the standards, the circuits are arranged in such a way that the breaker [11] cannot be locked unless the differential device [12] was locked beforehand, with the latter locking being achieved by means of an enabling device (not shown).

As shown in Figure 2, components [11] and [12] are enclosed respectively in two inseparable compartments.

Obviously, in order to use the device shown in Figure 2 to protect two or more lines in the subscriber network, two or more of these individual devices would have to be installed, along with a main breaker located upstream of these devices; or, alternatively, the arrangement shown in Figure 1 would have to be implemented, with the necessary modifications required for additional lines. However, doing so would lead to certain complications in the circuits, and would entail an increase in the amount of space required and also in the production cost. Nevertheless, no currently known proposal has proven that any other approach can be taken.

According to the present invention, the foregoing disadvantages are remedied by combining, in a unique single-unit electrical device, a single differential device and two or more automatic thermomagnetic breakers (one for each line), in order to allow one or more lines to remain in service independently of each other.

According to one of its embodiments (which are provided as non-limitative examples), the invention for two output lines is shown in Figure 3. It will immediately be understood that for a number of subscribers $\underline{n}$, where $\underline{n}$ is greater than 1, the arrangement will include a single differential device and $\underline{n}$ thermomagnetic breakers, which can be locked or disconnected independently by operating the control levers [18] shown in Figure 3.

Nevertheless, when the differential device is excited (by means of the trigger mechanism [16]), the differential device ensures the exclusion of all of the lines.

In terms of the electrical circuit as a whole, the electrical input conductors (2 for a single-phase line, 3 for a three-phase line, and 4 for a three-phase line with neutral), which form a winding on the transformer of the differential device, are connected in parallel to the transformer output, because they are connected directly to each thermomagnetic breaker.

Obviously, instead of being implemented in accordance with Figure 3, the assembly can be created by placing the differential device between the two thermomagnetic breakers.

As a non-limitative example, assuming the combination of a differential device [12] that has the following characteristics: I_N 0.03 A and I = 25 A, of the type mentioned hereinabove, with two breakers [11], the first of which consists of an automatic bipolar breaker having, as a characteristic, I_N = 10 A, and the second of which consists of an automatic bipolar breaker having, as a characteristic, I_N = 15 A, with the electrical diagram of the internal connections consisting of the one shown in Figure 3. This example pertains to the protection and isolation (cut-off) of a normal residential installation of average size, equipped with a 10A [10-ampere] lighting circuit and a 15A [15-ampere] power circuit. As can be seen, the functions (1) (2) and (3), as shown in Figure 1, are fulfilled:

1) Overall multipolar isolation (cut-off): When the lever [17] of the differential device is placed in the "Open" position, the two breakers [11], for the 10A and 15A circuits, respectively, are opened, thereby cutting off power to the entire installation.

2) Protection against overcurrents on the two cables with different cross-sections that supply power to the two different lighting and power circuits: This protection is provided separately by the two automatic breakers [11], for the 10A and 15A circuits, respectively, with the thermal relay [13] and the electromagnetic relay [14]. This protection is also selective, inasmuch as, in the event of an overcurrent in the "power" circuit, the 15A automatic breaker is triggered, but the 10A lighting circuit can remain in service. The same thing occurs conversely if the overcurrent is present in the lighting circuit.

3) Protection against contact voltages: Current leakage to ground at a value in excess of I x E_N, at any point in the installation, causes the excitation of the differential device [12] and therefore the triggering of all of the breakers. The device is reset and power is restored when the lever of the differential device [12] and then the levers of the automatic breakers [11] are moved to the closed position. However, the one for the line that is operating properly will remain closed, while the one for the line displaying a fault will cause a new triggering of the device as a whole.

Thus, the subscriber will know which of these two lines (light and power) has been affected by a ground fault, so that by leaving this line open, the subscriber can reclose the other circuit, which will remain in service while the necessary repairs are performed on the circuit that suffered the failure. This allows a manual selection to be made in order to detect the failure or fault.

It should be added that, unlike what happens with the use of the currently known simple differential breakers (which are referred to as "pure" differential breakers), the differential device – even in the event of an outright short circuit downstream of the installation – is reliably protected against the thermal and electromagnetic effects of a short circuit, up to the maximum value indicated on the manufacturer's data plate, because the amount of energy that is allowed to pass by a single automatic breaker is substantially smaller than the amount that can be accepted by the differential section, which is dimensioned for the sum of the currents passing through the two automatic breakers.

Obviously, the functional behavior described hereinabove occurs even if there are more than two automatic breakers (and when, instead of being single-phase lines, the lines to which power is supplied are three-phase lines or three-phase lines with neutral). Furthermore, in countries in which the electrical-power distribution companies guarantee that neutral is grounded and can even serve as a protective conductor, in single-phase installations each individual section of the breaker will consist of a single pole of the automatic breaker. Obviously, the conductor provided for the neutral [2], which in this case may be isolated, will also be wound on the differential transformer and will lead to two independent terminals. The foregoing advantages can easily be demonstrated:

- Reduced overall space requirement: In the practical example of protection described hereinabove for a single-phase installation with two lines, in accordance with the diagram shown in Figure 1, the differential device with a main breaker, of the commercially available type, has a modular dimension equal to 1, whereas a bipolar breaker has a dimension of 0.5, such that the total modular dimension is 1 + 0.5 + 0.5 = 2. The arrangement shown in Figure 1 can also be implemented through the use of two devices, as shown in Figure 2, in which case the total modular dimension will be (0.5 + 0.5) x 2 = 2, whereas with the device according to the present invention, the total dimension is 0.5 + 0.5 + 0.5 = 1.5;

- Reduced manufacturing costs: This is obvious, if one considers the smaller number of parts that need to be manufactured and assembled;

- Reduced installation costs: Figure 1 shows (in broken lines) the connections that the installation must make with the system that has been implemented up to the present time, and which disappear with the single-unit device according to the present invention (Figure 3);

- Overall improvement in safety: In the traditional system, and with the use of a simple differential [breaker] (which costs less than the thermomagnetic differential [breaker]), if a short circuit occurs at any of the connection points linked by the broken lines in Figure 1, which are vulnerable points, the pure differential [breaker] is deprived of its protection; and if the current in the short circuit reaches a high value, this differential [breaker] can even be seriously damaged. This risk, although infrequent, absolutely does not exist with the proposed single-unit device, because the vulnerable points, which are protected by the housings, are inaccessible.

Thus, it is obvious that the single-unit device according to the present invention can also be implemented in such a way as to provide a subset of the functions described hereinabove, thereby ensuring, in any event, advantages over the solution that has been implemented in installations up to the present time, including, in particular, those functions in which the protection against contact voltages is provided in a different way (for example, by coordinating the ground installation with the automatic breakers or through the use of isolation [i.e., one-to-one] transformers), [in which case] the single-unit device will include a main breaker but without the differential transformer [15] or the trigger mechanism [16], as well as two or more automatic breakers [11].

In this case, functions (1) and (2), as described in the introduction to the present descriptive specification, will be implemented. Here again, manufacturing and installation costs will be reduced, and overall safety will be improved.

-CLAIMS-

1. - Monobloc electrical system with three functions, to wit general disconnection, protection against contact voltage, protection against overload, by feeding at least two output wires, which are comprised of a general disconnecting switch on the input wire, a differential controller , two or an even larger number of thermo-magnetic circuit breakers, because there is one per wire, on said differential controller, in the case of spreading ground current it starts a system of alignment which simultaneously disconnects all the thermo-magnetic circuit breakers, the differential controller is comprised of a lever or a push button for reconnecting the alignment system and the thermo-magnetic circuit breakers to each lever or button by connecting the output wires.

2.- System according to the claim 1, in which the differential controller is provided with a means of clearance which allows for shut off of the thermo-magnetic circuit breakers.

3.- System according to claim 1, described as that in which the connections between the differential controller and the thermo-magnetic circuit breakers are inaccessible, being protected in this way by the casing of the system itself.

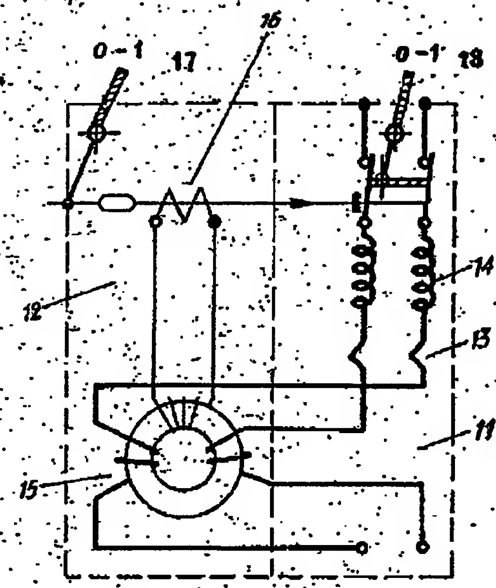

Fig.2

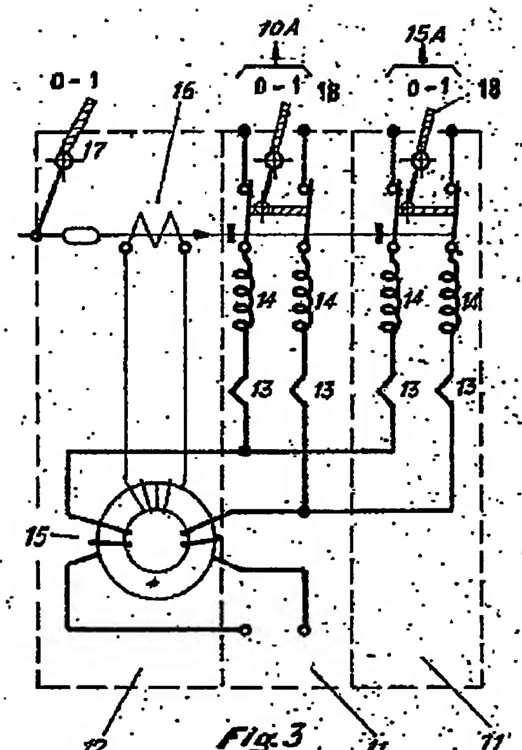

Fig.3

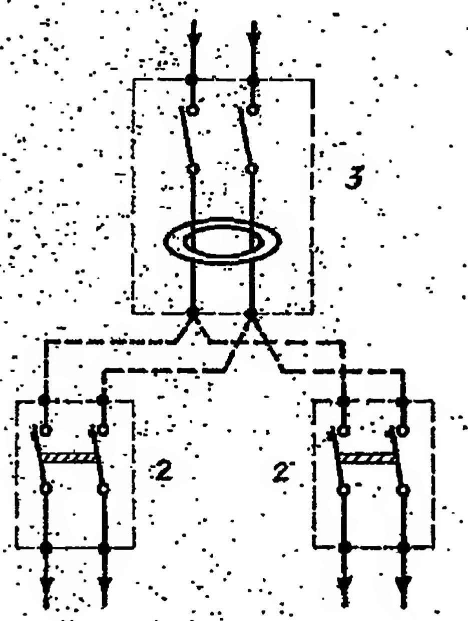

Fig.1